2016-07-05

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EVALUATION OF A FLOATING TIDAL TURBINE DEVICE USING A COUPLED CFD APPROACH

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ABSTRACT

The present work assesses the Modular Tide Generators (MTG) platform concept (see Fig. 1), at full scale, in conditions based on those at the Perpetuus Tidal Energy Centre (PTEC) site. To evaluate this device, a coupled, fully-nonlinear numerical model has been developed within the open-source CFD environment, OpenFOAM. The model solves the incompressible Reynolds-Averaged Navier Stokes equations and incorporates a floating barge, hybrid-catenary mooring system and a submerged tidal turbine with over-speed control, represented by a two-way coupled, actuator line approach [1].

Expression-based boundary conditions have been used to generate the waves and currents, which have been absorbed using the relaxation zone formulation [2]. The barge has been modelled, both with (loaded) and without (unloaded) the turbine; under a range of different wave, current and wave-current conditions. In each case, the device has been assessed for a number of properties, including the motion of the barge, tension in each of the mooring lines as well as power output and thrust on the turbine.

The behaviour of the unloaded, unmoored barge is consistent with results from a potential flow solver. However, when the complete system is considered, the fully coupled CFD model predicts additional complexities not captured by the simpler numerical model. This has a significant impact on the power output from the device, indicating that a coupled, fully non-linear, six degree of freedom, numerical model is necessary to accurately evaluate the performance of floating offshore devices.

Figure 1: Snapshot of the loaded MTG platform in waves and currents.

REFERENCES

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